IDSP

Industrial
Disease
Standards
Panel

Interim Report to the Workers' Compensation Board on Scleroderma

March 31, 1992

Industrial Disease Standards Panel
IDSP Report of Findings No. 8
Toronto, Ontario

92-07876/

Industrial Disease Standards Panel

In 1985 the Ontario legislature established the Industrial Disease Standards Panel (IDSP) to investigate and identify diseases related to work. The Panel is independent of both the Ministry of Labour and the Workers' Compensation Board. At the end of each fiscal year the WCB reimburses the Ministry for the Panel's expenditures.

The Panel's authority flows from section 95 of the *Workers' Compensation Act* and its functions are set out as follows:

(8) (a) to investigate possible industrial diseases;

(b) to make findings as to whether a probable connection exists between a disease and an industrial process, trade or occupation in Ontario;

(c) to create, develop and revise criteria for the evaluation of claims respecting industrial diseases; and

(d) to advise on eligibility rules regarding compensation for claims.

Decisions of the Panel are made by its members who represent labour, management, scientific, medical and community interests. Once the Panel makes a finding, the WCB is required to publish the Panel's report in the Ontario Gazette and solicit comments from interested parties. After considering the submissions the WCB Board of Directors decide if the Panel's recommendations are to be implemented, amended or rejected.

To assist with its work the Panel has a small staff of researchers, analysts and support people. In addition to its own staff, the Panel relies heavily on the advice of outside experts in science, medicine and law, as well as input from the parties of interest.

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March 31, 1992

Mr. Odoardo Di Santo
Chairman
Workers' Compensation Board
2 Bloor Street East, 20th Floor
Toronto, Ontario
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Dear Mr. Di Santo:

I am pleased to present you with the IDSP Interim Report of Findings on Scleroderma in accordance with Section 86p(10) of the Workers' Compensation Act.

Yours sincerely,

Nicolette Carlan
Chair

NC:cr

Panel Membership

Panel Members	*Appointment*
Ms. Nicolette Carlan (Chair)	May 16, 1991 to May 15, 1994
Dr. Carol Buck	June 1, 1991 to June 16, 1994
Mr. James Brophy	January 23, 1992 to January 22, 1995
Mr. William Elliott	November 7, 1991 to November 6, 1994
Mr. David Leitch	November 7, 1991 to November 6, 1994
Mr. John Macnamara	November 7, 1991 to November 6, 1994
Mr. Homer Seguin	May 28, 1989 to May 27, 1992
Dr. Michael Wills	November 7, 1991 to November 6, 1994

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Origin and Background of the Referral

On May 22, 1991, the Chair received a letter from Mr. Gilles Bisson, MPP for Cochrane South, who requested that the Industrial Disease Standards Panel investigate the connection of "people who work in the mining profession and the symptoms of scleroderma" (1). The MPP was aware of two miners in his constituency who purportedly were suffering from the disease. Coincident with this referral, a third case, also in a miner, appeared in newspaper accounts in a different area of the Province.

How the Panel Proceeded

Since this was the first time that the Panel received a referral from an MPP on behalf of his or her constituents IDSP staff conducted a limited review of the literature to see if there was any evidence indicative of a serious problem. The Ontario Workers' Compensation Board provided the Panel with information indicating that their database showed eight claims for scleroderma, the earliest being filed in 1986. Two were rejected, two were allowed and four are pending. Staff also investigated other jurisdictions, both in Canada and internationally, to see if there were any existing policies concerning scleroderma and possible occupational associations. This initial research resulted in the preparation of a "Background Paper on Scleroderma" which was tabled at Panel Meeting No. 45, November 18, 1991 (2). The Panel was satisfied that there exists some information which is suggestive of a relationship between this disease and exposure to silica or some other agent. Accordingly, the Panel voted to place the issue of Scleroderma on its Agenda at its November, 1991 meeting.

The Panel requested that staff investigate the two allowed and two rejected claims to see if particular adjudicatory problems would come to light.

The IDSP then commissioned an exhaustive review of the literature to be conducted by rheumatologist, Dr. Duncan A. Gordon, Professor of Medicine at the University of Toronto, Senior Rheumatologist, The Toronto Hospital Arthritis Centre, and Editor of the Journal of Rheumatology. This report was received February 1, 1992. Some clarifications and refinements resulted in a final report being tabled with the Panel at their meeting on March 18 and 19, 1992 (3).

Also, the WCB made available to the Panel an internal review of the literature that had been prepared by Board staff in the Medical and Occupational Disease Policy Branch (4). This internal document had been precipitated by claims pending at the WCB for this disease. It was also tabled with the Panel.

The Nature of the Disease

The following paragraphs reflect the combined research of IDSP staff and Dr. Gordon.

Scleroderma [literally, hardening of the skin] was first described by Carlo Curzo of Naples in 1753 (5). Not until 1900 was it realized that this thickening and induration [attachment to underlying structures] of the skin frequently involved the visceral organs as part of the same process and that subsequent malfunction of these organs could be rapidly progressive and frequently fatal.

Progressive systemic sclerosis [PSS] is a multisystem disorder characterized by inflammatory, vascular and fibrotic changes. Skin, blood vessels, joints and skeletal muscle are primarily affected, but the gastro-intestinal tract, lungs, heart and kidney may also be severely affected. Scleroderma is a member of a family of diffuse connective tissue disorders which includes systemic lupus erythematosus [SLE], rheumatoid arthritis [RA], polymyositis or dermatomyositis, vasculitis and Sjogren's syndrome (3).

Scleroderma may be divided on the basis of the extent of skin involvement into two different types, **systemic** or **localized**. **Systemic** forms involve vital organs such as lung, heart and kidney, are progressive and associated with premature disability and death. **Localized** forms are usually confined to the skin, often associated with Raynaud's phenomenon, and do not involve vital organs. Some localized scleroderma-like disorders can be chemically-induced and are sometimes of occupational origin but will not be considered further because of their limited effects (6).

For ease of discussion, the term "scleroderma" as used in this paper, is synonymous with systemic sclerosis.

Systemic sclerosis may be further sub-divided into two forms, **diffuse** or **limited cutaneous scleroderma**. The **diffuse** type of scleroderma is associated with more severe arthritis, a more accelerated course including early involvement of the visceral organs, a worse prognosis and a higher incidence of mortality than is associated with limited scleroderma. In **limited cutaneous scleroderma**, involvement can be restricted to the fingers or face with the disease progressing slowly—hence a better prognosis unless pulmonary hypertension intervenes.

Scleroderma is a rare disease which is three times more common in women. Total annual incidence is about 4/1,000,000 ranging from 8.3/1,000,000 in white males to 28/1,000,000 in white females, and even higher in black females. Poorer prognosis is seen in men and blacks, in persons with disease onset after 40 years of age and in those with more extensive skin involvement of the type seen in diffuse cutaneous scleroderma.

Panel staff examined the files of two workers whose claims had been denied by the WCB. Both had been diagnosed as having systemic sclerosis. One worker was a caster/moulder who ground steel, copper and brass and had been employed in this capacity for 10 years. Masks had been worn the last three years. The second worker was a sandblaster and spray painter employed for 7 years. In this claim, the worker's rheumatologist informed the Board of a possible workplace association with silica.

Both claims were denied because the occupational link was not accepted. There was no question of diagnosis.

Scleroderma and its Occupational Associations

Scleroderma-like disorders have been attributed in the literature to vinyl chloride, trichloroethylene, perchloroethylene, miscellaneous organic solvents, epoxy resin hardener, and silica (6). The characteristic changes due to vinyl chloride disease, found primarily among workers who scrape the vats of unreacted vinyl chloride [VC] monomer, usually revert to nearly normal following cessation of exposure. The reports attributing scleroderma to various solvent exposures are regarded as largely anecdotal (7). Besides VC disease, the vast majority of cases of occupational scleroderma have been described in association with silica exposure in South Africa, Pennsylvania and the German Democratic Republic.

Reports of lung complications of scleroderma in Scottish stonemasons and a coal-miner first appeared in 1914 (8) but not until the 1957 report by Erasmus from South Africa was the relationship of occupational silica exposure and scleroderma noted (9). Erasmus reported 17 cases of scleroderma among gold miners who were exposed to dust containing a high percentage of free silica[+/- 30%]. Only six showed radiologic features of silicosis.

In the same country, Sluis-Cremer et al. (10) in 1985 reported a case-control study of 79 white European gold miners. They failed to find an increase in silicosis among those with scleroderma but did demonstrate a consistent pattern of heavy exposure to dust among cases, intensity appearing to be more important than duration.

In contrast to scleroderma found in white European miners, Cowie reported in 1987 and 1990 on a total of 24 black coal miners from the Orange Free State seen over the period 1981–1988 (11,12). Sixty percent of these cases showed evidence of pulmonary silicosis. Incidence of scleroderma in this group was 81.8/1,000,000 black men aged 33 to 57 vs. 3.4/1,000,000 black men of similar age in the general population.

A decade after the Erasmus study, Rodnan (13) reported on his experience with 150 scleroderma patients, 60 of whom were men. Twenty-six of the men or 43% had worked as coal miners or in other occupations with silica exposure. These men, whose average age was 52, were of the same middle European extraction as the white miners reported on by Erasmus and the East German miners described below. Silicosis was confirmed in 8 of the 19 patients for whom radiographs were available.

The prevalence of scleroderma based on hospital discharges from the Miners Memorial Hospital Association in the Appalachian region outside Pittsburgh was 17/100,000 for miners compared with 6/100,000 for non-miners and 9/100,000 for women.

In a further analysis, of 43 males with scleroderma admitted

to University Hospital in Pittsburgh, 47% had been exposed to silica compared with 19% exposed in 86 matched male patients from the same hospital but without scleroderma. It was estimated that 20% of men in a 100 mile radius of Pittsburgh had been exposed to silica, yet 47% of men with scleroderma in the same area were known to have been exposed to silica.

Haustein et al. report on all cases of scleroderma seen in the German Democratic Republic for the period 1981-88 (6,14-16). Of 120 white males with scleroderma, 93 had been exposed to silica dust and 49 had silicosis. A more detailed investigation of 40 subjects from this latter group revealed features in keeping with diffuse idiopathic scleroderma. The diagnostic criteria of the American Rheumatism Association (17) were met in 38 of these patients.

The Rodnan and Haustein data would seem to reinforce findings reported by Rustin (18) who also examined a group of miners from East Germany. After studying 17 mine workers who developed a systemic sclerosis-like disease and met ARA criteria, the authors report that "these patients had clinical, immunological and serological features which are indistinguishable from the idiopathic form of the disease".

Other Jurisdictions

In Canada, it would appear that no jurisdiction has policy or guidelines with respect to adjudicating scleroderma claims.

Scleroderma was recognized as an occupational disease in the former German Democratic Republic. Its status after reunification is unclear. Dr. U. Haustein of Karl Marx University, Leipzig, has described the adjudication process as case-by-case (19). Each patient is discussed by a committee of experts (Obergutachtenkommission). Careful consideration is given to all facts such as occupational exposure time to silica, working conditions, interval until the manifestation of the disease, association with silicosis, etc.

In South Africa, scleroderma is mentioned in the *Occupational Diseases in Mines and Works Act (78 of 1973)*. This act originated in 1911 and was aimed at improving working conditions in all South African mines. Many aspects of the Act relate to "risk work" and "compensatable disease". Risk work, in practice, is all work below the natural surface of the earth and certain surface operations (work in crusher houses, reduction plants, and on slime dams). The criterion in subsection (2) [defining risk work] is whether any person is exposed to:

a. dust of which the composition and concentration is such that it is in the opinion of the Minister harmful or potentially harmful;

or

b. gases, vapours or chemical substances, or factors [in] working conditions, which in the opinion of the Minister, are potentially harmful.

Section 1 defines "compensatable disease" and paragraph e. of that section reads as follows:

e. "Any other permanent disease of the cardio-respiratory organs which, in the opinion of the certification committee*, is attributable to the performance of risk work; or progressive systemic sclerosis which, in the opinion of the certification committee, is attributable to the performance of risk work."
* [Medical Certification Committee for Occupational Diseases, established under Section 39]

Panel Conclusions

The Question of Causation

In his classic address on causation, Sir Austin Bradford Hill discussed some parameters which he deemed useful in bridging the gap from an observed association to a verdict of causation (20). As Rothman later notes, Hill clearly did not intend that these criteria be used as some kind of "checklist" or hard-and-fast rules for causal inference (21). Nevertheless, as Hill himself says, "What they can do, with greater or less strength, is to help us to make up our minds on the fundamental question—is there any other way of explaining the set of facts before us, is there any other answer equally, or more, likely than cause and effect?"

While acknowledging that the criteria are too restrictive in and of themselves to form the basis for sound public policy the Panel feels that the criteria can provide a useful structure for thinking about possible workplace associations. As proposed by Hill they are: (1) strength, (2) consistency, (3) specificity, (4) temporality, (5) biologic gradient, (6) plausibility, (7) coherence, (8) experimental evidence, and (9) analogy.

Strength and Consistency

Scleroderma is an uncommon disease of unknown etiology. The literature on the disease itself is not extensive. Reports of possible occupational associations are even more limited. Therefore what is striking in the literature on scleroderma reviewed for this report is the repetition of the association between this disease and an occupational history of exposure to free silica and/or vibratory tools.

Rodnan and colleagues at the University of Pittsburgh found over twice as many of their male scleroderma patients had been exposed to silica as had been males in the surrounding geographical area. Haustein and colleagues in Eastern Germany claim to have calculated that the likelihood for the development of scleroderma in male silicotic patients older than 40 years of

age is approximately 190 times higher than in men without silicosis and approximately 50 times higher in persons exposed to silica dust but without silicosis than in the nonexposed male population. In South Africa, Sluis-Cramer et al. and Cowie et al. have both reported an increased incidence of scleroderma among men exposed to silica dust. Unfortunately, in none of these studies has an attempt been made to examine exposure to vibratory tools as well as silica.

Although we acknowledge that these studies are difficult to compare and that most evidence is descriptive in nature, a definitive epidemiologic study is unlikely to be conducted, owing to the rarity of this disease. The repeated occurrence of a very rare disease, at least three times more common in women, in males occupationally exposed to silica is suggestive of a causal association.

One dissenting voice in the literature is that of Dr. J.R. Ruettner, a Swiss pathologist who is a member of the Silicosis Committee of the United States National Institute for Occupational Safety and Health. Dr. Reuttner challenges the existence of this relationship by the statement, "Among over 2,000 cases of silicosis, only four had scleroderma... Moreover not a single case of scleroderma was observed in 650 cases of silicosis that underwent an autopsy" (8). His experience is supported in the literature, to some extent, which does not establish a consistent relationship between scleroderma and silicosis. For example, the reports of Erasmus, Rodan and Haustein show less than 50% of the scleroderma cases were associated with pulmonary silicosis. However, the relationship identified in the literature is the relationship between silica exposure and scleroderma, and not the relationship between silicosis and scleroderma. Furthermore, the reported absence of a diagnosis of scleroderma in the silicotic patients could have resulted from poor detection of the disease rather than an absence of the disease. As Dr. Gordon states, "scleroderma is invariably a clinical, not a pathological diagnosis [and] rheumatological aspects unless specifically sought could have been easily overlooked" (3).

A population-based case-control study of connective tissue disease conducted in Georgia attempted to collect information on purported environmental and occupational factors, such as silica (22). However the study included only 4 men of 44 total cases.

Specificity, Plausibility and Coherence

It is unfortunate that detailed occupational exposure assessments are lacking and other possible exposures cannot be definitively ruled out. For example, vibration is known to be capable of causing Raynaud's phenomenon and with use of vibratory tools, occupational exposure to dust will likely occur. It could be argued that silica exposure is a surrogate measure for vibration or some

other exposure. Although large numbers of the cases in question are miners, other occupations represented have included stonemasons, foundry workers, quarrymen, glass grinders, sandstone-sculptor and cast polisher. Silica is one obvious occupational agent in common.

Some authors have speculated as to how silica might act in the pathogenesis of scleroderma. Haustein and colleagues (6,14) have posed that silica particles, ingested by macrophages, lead to release of lymphokines and monokines, which activate fibroblasts, and enhance collagen and glycosaminoglycan synthesis or that silica acts as an adjuvant, increasing immune reactivity. The adjuvant theory is also postulated by Rodnan (13). Sluis-Cremer et al. (10) speculate that "there is an underlying genetically determined constitutional diathesis predisposing a person to PSS. Silica may, through its known profound effects on the immune system, precipitate the disease in those disposed".

In summary, in numerous studies of scleroderma, silica has been implicated as the causal agent, and it is biologically plausible that silica could induce scleroderma in susceptible individuals.

Temporality and Biological Gradient

The retrospective nature of the published studies makes it difficult to say with certainty that the exposure preceded the disease in all cases. The duration of exposure to silica dust in the cases of scleroderma described in the literature ranges from a minimum of 3 years to a maximum of 42 years. However, research in South Africa indicates that intensity of exposure to silica is more important than duration. The South African findings of a decrease in the association of scleroderma with pulmonary silicosis in more modern times could be attributed to better dust control. This could also help to account for the findings in East Germany of Rustin who found more of the limited type of scleroderma than the diffuse variety in his report in 1990. It has been hypothesized that an intense exposure to silica, even of short duration, could overwhelm the pulmonary lymphoid system and give rise to a wider systemic effect (3). There would appear to be some evidence of a biological gradient on the basis of intensity of exposure.

Experimental Evidence and Analogy

As mentioned above, there would appear to be a decrease in the number of diffuse scleroderma cases in the most recent report from South Africa (10). Although speculative, one could postulate that this was due to better dust control and hence lowered silica exposure.

The recent outbreak of the eosinophilic-myalgia syndrome in the United States attributed to a contaminated health food could possibly be considered an analogous environmentally-caused connective tissue disorder (23).

Summary

At the conclusion of his address, Hill states:

"All scientific work is incomplete—whether it be observational or experimental. All scientific work is liable to be upset or modified by advancing knowledge. That does not confer upon us a freedom to ignore the knowledge we already have, or postpone the action that it appears to demand at a given time" (20).

The knowledge we have now is that a number of publications in reputable peer reviewed medical journals offer evidence gathered over four decades in different parts of the world indicating a probable relationship between occupational exposure to silica and systemic sclerosis or scleroderma. In two jurisdictions this evidence has been considered adequate to extend workers' compensation benefits to those with scleroderma and an occupational history of exposure to silica. There is no evidence which discounts the relationship.

We have also considered the issues raised by a staff physician in an internal WCB staff report. While acknowledging the existence "of some evidence to support a causal association between systemic sclerosis and occupation as a miner", the physician wrote that "the level of excess risk cannot be estimated and the specific causal agent has not been identified. Both silica dust exposure and vibration have been hypothesised to be the causal agents. Studies to date do not confirm these hypotheses" (4).

In consideration of these concerns, the Panel is reminded that inconclusive epidemiologic evidence does not weigh against the possibility of causal association; it merely leaves the scales untipped. A definitive epidemiologic study is unlikely to be conducted owing to the rarity of this disease.

As noted above, scleroderma is sometimes but not always associated with silicosis in exposed workers. The development of silicosis is usually associated with long term exposure to silica. The duration of exposure to silica dust in the cases of scleroderma described in the literature range from a minimum of three years to a maximum of 42 years. Also, as noted above, intensity of exposure would seem to be more important than duration. In reaching a conclusion on this uncommon disease, the Panel is satisfied that the evidence is supportive of a causal relationship between silica exposure and scleroderma.

Findings and Recommendations

FINDINGS

The Panel finds a probable connection between systemic sclerosis and occupational exposure to silica.

The Panel recommends the following rule:

ELIGIBILITY RULE:

A) Workers suffering from systemic sclerosis [scleroderma] with occupational exposure to silica for a minimum of three years are entitled to compensation

or

B) Claims from workers with less than three years exposure shall be considered on their own merits. Claims from workers who have experienced high intensity exposure to silica shall be given special consideration.

It is possible that scleroderma should ultimately be placed in Schedule 3. Because the Panel notes that this jurisdiction is lacking in experience with claims of this nature, it has chosen the more cautious route of eligibility rules. The Panel proposes a review of this issue in three years time or earlier if new information becomes available.

Because of the rarity of this disease and the lack of awareness of this causal association the Panel makes the following recommendation:

RECOMMENDATION 1:

The Board issue an information bulletin to promote awareness among stakeholders of the association between silica and systemic sclerosis [scleroderma].

Future Panel Activity

As discussed previously, there is legitimate concern that the occupationally-associated scleroderma observed in the literature could be attributable, at least in part, to use of vibratory tools. This theory was most recently raised by Pelmear et al (24). The Panel intends to further examine the evidence for this association and reserves the right to recommend additional eligibility rules if it deems them necessary.

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